Program Review Charge
Homeland Security Research Subcommittee

1.0 Objective

The Board of Scientific Counselors (BOSC) Homeland Security Research Subcommittee will conduct a prospective and retrospective review of the Office of Research and Development's (ORD's) Homeland Security Research Program (HSRP), evaluating the program's relevance, quality, progress, scientific leadership, communication, coordination and impact. The BOSC's evaluation and recommendations will provide guidance to ORD to help:

- Plan, implement, and strengthen the HSRP;
- Compare the HSRP with other programs designed to achieve similar outcomes both in other parts of EPA and in other federal agencies;
- Make ORD investment decisions over the next five years;
- Prepare EPA's performance and accountability reports to Congress under the Government Performance and Results Act; and
  Respond to assessments of federal research and development programs such as those conducted by the Office of Management and Budget (OMB highlights the value of recommendations from independent expert panels in guidance to federal agencies.[1,2]

2.0 Background Information. Independent expert review is used extensively in industry, federal agencies, Congressional committees, and academia. The National Academy of Science has recommended this approach for evaluating federal research programs.[3]

Because of the nature of research, it is not possible to measure the creation of new knowledge as it develops–or the pace at which research progresses or scientific breakthroughs occur. Demonstrating research contributions to outcomes is very challenging[4] when federal agencies conduct research to support regulatory decisions, and then rely on third parties[5]–such as state environmental agencies–to enforce the regulations and demonstrate environmental improvements. Typically, many years may be required for practical research applications to be developed and decades may be required for some research outcomes to be achieved in a measurable way.

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[1] Budget Data Request 04-31. Executive Office of the President, Office of Management and Budget. March 22, 2004. "Completing the Program Assessment Rating Tool (PART) for the FY06 Review Process," pages 50-56.
[2] Memorandums for the Heads of Executive Departments and Agencies. Executive Office of the President, Office of Management and Budget. June 5, 2003. "FY 2005 Interagency Research and Development Priorities," pages 5-10.
[3] Evaluating Federal Research under the Government Performance and Results Act (National Research Council, 1999).
[4] The House Science Subcommittee. Letter to Dr. Bruce Alberts, President of the National Academy of Sciences, from F. James Sensenbrenner, Jr. and George E. Brown. October 23, 1997.
[5] The Government Performance and Results Act: 1997 Government Wide Implementation Will Be Uneven. U.S. General Accounting Office. (GAO/GGD, 1997)

Most of ORD's environmental research programs investigate complex environmental problems and processes – combining use-inspired basic research[6,7] with applied research, and integrating several scientific disciplines across a conceptual framework[8] that links research to environmental decisions or environmental outcomes. In multidisciplinary research programs such as these, progress toward outcomes can not be measured by outputs created in a single year. Rather, research progress occurs over several years, as research teams explore hypotheses with individual studies, interpret research findings, and then develop hypotheses for future studies.

In designing and managing its research programs, ORD emphasizes the importance of identifying priority research questions or topics to guide its research. Similarly, ORD recommends that its programs develop a small number of performance goals that serve as indicators of progress to answer the priority questions and to accomplish outcomes. Short-term outcomes are accomplished when research is applied by specific clients, e.g., to strengthen environmental decisions. These decisions and resulting actions (e.g., the reduction of contaminant emissions or restoration of ecosystems) ultimately contribute to improved environmental quality and health.

In a comprehensive evaluation of science and research at EPA, the National Research Council[9] recommended that the Agency substantially increase its efforts to both explain the significance of its research products and to assist clients inside and outside the Agency in applying them. In response to this recommendation, ORD has engaged science advisors from client organizations to serve as members of its research program teams. These teams help identify research contributions with significant decision-making value and help plan for their transfer and application.

For ORD's environmental research programs, periodic retrospective analysis at intervals of four or five years is needed to characterize research progress, to assess how clients are applying research to strengthen environmental decisions, and to evaluate client feedback about the research. Conducting program evaluations at this interval enables assessment of: research progress, the scientific quality and decision-making value of the research, and whether research progress has resulted in short-term outcomes for specific clients.

A description of the OSTP/OMB *Research and Development Investment Criteria* is included in Appendix I.

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[6] Building a Foundation for Sound Environmental Decisions. (National Research Council, 1997).
[7] Renewing the Compact between Science and Government, Stokes, D.E., in 1995 Forum Proceedings, Vannevar Bush IIScience for the 21st Century. Pages 15-32. Sigma Xi, 1995.
[8] Risk Assessment in the Federal Government: Managing the Process. (National Research Council, 1983).
[9] Strengthening Science at the U.S. Environmental Protection Agency. (National Research Council, 2000, p 141).

3.0 Background Information on the Homeland Security Research Program/Charge Questions

Following the terrorist attacks of September 11, 2001, and the mailing of anthrax-contaminated letters later that year, the U.S. Environmental Protection Agency (EPA) developed a Strategic Plan for Homeland Security[1] committed to enhancing national security and protection of human health and the environment. The Strategic Plan and several Homeland Security Presidential Directives (HSPDs)[2,3,4] provided the basis for creation and mission of ORD's National Homeland Security Research Center (NHSRC) in 2002. NHSRC was originally planned to be in existence for three years. It was thought that existing technologies and methodologies could be applied to chemical, biological and radiological agents of terror to result in those technologies being able to detect, contain, decontaminate and dispose of agents of terror. However, upon gaining access to detailed agent data, NHSRC learned that far less technical information for these agents of terror existed than was originally expected. Therefore, the life of the Center was extended indefinitely to develop needed agent data and complete its mission. Additionally, reviews of NHSRC programs by the National Academies of Science (NAS)[5,6] as well as commentaries by other federal organizations, recommended that NHSRC continue as an organization within EPA to address national security research needs related to protecting human health and safeguarding the environment. NHSRC became a permanent part of the Office of Research and Development (ORD) in late 2004 with the responsibility to plan and implement EPA's Homeland Security Research Program (HSRP).

The HSRP is a component of the Agency-wide homeland security program that carries out the following responsibilities defined by law and Presidential Order:

1. Protecting water systems and detect and recovering from terrorist attacks affecting water systems. EPA is the federal government's Sector Specific Agency (SSA) for water.
2. Decontaminating buildings and outdoor areas impacted by a terrorist attack.
3. Developing a nationwide laboratory network to support routine monitoring and response requirements.

The HSRP conducts research to meet the science needs of other components of EPA's homeland security program, primarily the Office of Water (in association with water utilities) and the Office of Solid Waste and Emergency Response (in association with EPA Regions). The HSRP describes the research it plans to conduct for these clients over the next 3 to 4 years in the HSRP Multi-Year Plan (MYP), consistent with commitments published in the EPA-wide Homeland Security Work Plan.

The HSRP conducts a broad program of research and development in the following areas:

- Tools to help protect water systems from attack;
- Systems to detect attacks on water utilities;
- Sampling and analytical methods for chemical, biological and radiological (CBR) contaminants in environmental media (air, water, soil) and on surfaces;
- Methodologies to assess risks to human health from CBR agents and to determine risk-based cleanup goals that are protective of human health;

- Strategies to contain CBR agents following release and to minimize exposure to the public;
- Technologies to clean up CBR agents following attacks on water systems, buildings or outdoor areas:
- Methodologies to dispose of CBR contaminated wastes resulting from clean up.

4.0 Charge Questions

(1) Program Assessment (evaluate entire research program)

The responses to the program assessment charge questions below will be in a narrative format, and will capture the performance for the entire research program and all the activities in support of the program's Long term Goals (LTGs).

Program Relevance

1. How consistent are the Long Term Goals (LTGs) of the program with achieving the Agency's strategic plans and the draft Homeland Security Research Multi-Year Plan (MYP)?
2. How responsive is the program focus to EPA program office and regional homeland security research needs?
3. How responsive is the program to recommendations from outside advisory boards and stakeholders?
4. How clearly evident are the public benefits of the program?

Program Structure

1. How logical is the program design, with clearly identified priorities?
2. How clear a logical framework do the LTGs provide for organizing and planning EPA's homeland security research and demonstrating outcomes of the program?
3. How appropriate is the science used to achieve each LTG (i.e., is the program still asking the right questions, or has it been eclipsed by advancements in the field?
4. Does the draft MYP describe an appropriate flow of work (i.e., the sequencing of related activities) that reasonably reflects the anticipated pace of scientific progress and timing of client needs?
5. To what extent will the program's work benefit multiple needs (i.e., will the research, while primarily addressing homeland security needs, be useful in solving other environmental problems)?

Program Quality

1. How good is the scientific quality of the program's research products?
2. What means does the program employ to ensure quality research (including peer review, competitive funding, etc.), and how effective are these processes?

Scientific Leadership

1. Please comment on the leadership role the research program and its staff have in contributing to advancing the current state of the homeland security science.

2. Please comment on the leadership role the research program and its staff have in contributing science and expertise to federal homeland security policies and priority setting?

Coordination and Communication

1. How effectively does the program engage scientists and managers from relevant program offices in its planning?
2. How effectively does the program engage outside organizations, both within and outside government, to promote collaboration, obtain input on program goals and research, and avoid duplication of effort?
3. How effective are the mechanisms that the program uses for communicating research results both internally and externally?

Program Performance and Efficiency

1. How much are the program results being used by environmental decision makers to inform decisions and achieve results?[10]
2. How well-defined are the program's measures of outcomes?
3. How efficiently has the program invested and managed resources to achieve the LTGs?

(2) Summary Assessment (rate program performance by LTG)

The responses to the three summary assessment charge questions below will rate the performance for each LTG. For each LTG, a qualitative score will be assigned that reflects the quality and significance of the research as well as the extent to which the program is meeting or making measurable progress toward the goal—relative to the information and evidence provided to the BOSC. The scores will be given in the form of adjectives that are clearly defined and which are intended to promote consistency among reviews. The adjectives will be used as part of a narrative summary of the review of each LTG so that the context of the rating and the rationale for selecting a particular rating will be transparent. The rating may reflect considerations beyond the summary assessment questions, and will be explained in the narrative. The adjectives to describe progress are:

- Exceptional: indicates that the program is meeting all and exceeding some of its goals, both in the quality of the science being produced and the speed at which research result tools and methods are being produced. An exceptional rating also indicates that the program is addressing the right questions to achieve its goals. The review should be specific as to which aspects of the program's performance have been exceptional.
- Exceeds Expectations: indicates that the program is meeting all of its goals. It addresses the appropriate scientific questions to meet its goals and the science is competent or

[10] For this question, the BOSC should focus on the extent to which the program results are being used by EPA and related stakeholders in carrying out their homeland security responsibilities.

better. It exceeds expectations for either the high quality of the science or for the speed at which work products are being produced and milestones met.

- Meets Expectations: indicates that the program is meeting most of its goals. Programs meet expectations in terms of addressing the appropriate scientific questions to meet their goals, and work products are being produced and milestones are being reached in a timely manner. The quality of the science being done is competent or better.
- Not Satisfactory: indicates that the program is failing to meet a substantial fraction of its goals, or if meeting them, that the achievement of milestones is significantly delayed, or that the questions being addressed are inappropriate or insufficient to meet the intended purpose. Questionable science is also a reason for rating a program as unsatisfactory for a particular long term goal. The review should be specific as to which aspects of a program's performance have been inadequate.

For each program review, the summary assessment charge questions below will be tailored to the specific review and LTG:

1. How appropriate is the science used to achieve each LTG, i.e., is the program still asking the right questions, or has it been eclipsed by advancements in the field?

2. How good is the scientific quality of the program's research products?

3. How much are the program results being used by environmental decision makers to inform decisions and achieve results?[11]

[11] For this question, the BOSC should focus on the extent to which the program results are being used by EPA and related stakeholders in carrying out their homeland security responsibilities

Appendix I

OSTP/OMB Research and Development Investment Criteria

The Relevance, Quality, and Performance criteria apply to all R&D programs. Industry-relevant applied R&D must meet additional criteria. Together, these criteria can be used to assess the need, relevance, appropriateness, quality, and performance of federal R&D programs.

I. Relevance

R&D investments must have clear plans, must be relevant to national priorities, agency missions, relevant fields, and "customer" needs, and must justify their claim on taxpayer resources. Review committees should assess program objectives and goals on their relevance to national needs, "customer" needs, agency missions, and the field(s) of study the program strives to address. For example, the Joint DOE/NSF Nuclear Sciences Advisory Committee's Long Range Plan and the Astronomy Decadal Surveys are the products of good planning processes because they articulate goals and priorities for research opportunities within and across their respective fields. Programs that directly address Presidential priorities may receive special consideration for support, with adequate documentation of their relevance to those priorities.

OMB will work with some programs to identify quantitative metrics to estimate and compare potential benefits across programs with similar goals. Such comparisons may be within an agency or among agencies.

A. Programs must have complete plans, with clear goals and priorities. Programs must provide complete plans, which include explicit statements of: specific issues motivating the program; broad goals and more specific tasks meant to address the issues; priorities among goals and activities within the program; human and capital resources anticipated; and intended program outcomes, against which success may later be assessed.

B. Programs must articulate the potential public benefits of the program. Programs must identify potential benefits, including added benefits beyond those of any similar efforts that have been or are being funded by the government or others. R&D benefits may include technologies and methods that could provide new options in the future, if the landscape of today's needs and capabilities changes dramatically. Some programs and sub-program units may be required to quantitatively estimate expected benefits, which would include metrics to permit meaningful comparisons among programs that promise similar benefits. While all programs should try to articulate potential benefits, OMB and OSTP recognize the difficulty in predicting the outcomes of basic research. Discovery is a legitimate object of basic research, and some basic research investments may be justified on external judgments of the opportunity for discovery.

C. Programs must document their relevance to specific Presidential priorities to receive special consideration. Many areas of research warrant some level of federal funding. Nonetheless, the President has identified a few specific areas of research that are particularly

important. To the extent a proposed project can document how it directly addresses one of these areas, it may be given preferential treatment.

D. Program relevance to the needs of the Nation, of fields of science and technology, and of program "customers" must be assessed through prospective external review. Programs must be assessed on their relevance to agency missions, fields of science or technology, or other "customer" needs. A customer may be another program at the same or another agency, an interagency initiative or partnership, or a firm or other organization from another sector or country. As appropriate, programs must define a plan for regular reviews by primary customers of the program's relevance to their needs. These programs must provide a plan for addressing the conclusions of external reviews.

E. Program relevance to the needs of the Nation, of fields of science and technology, and of program "customers" must be assessed periodically through retrospective external review. Programs must periodically assess the need for the program and its relevance to customers against the original justifications. Programs must provide a plan for addressing the conclusions of external reviews.

II. Quality

Programs should maximize the quality of the R&D they fund through the use of a clearly stated, defensible method for awarding a significant majority of their funding. A customary method for promoting R&D quality is the use of a competitive, merit-based process. NSF's process for the peer-reviewed, competitive award of its R&D grants is a good example. Justifications for processes other than competitive merit review may include "outside-the-box" thinking, a need for timeliness (e.g., R&D grants for rapid studies in response to an emergency), unique skills or facilities, or a proven record of outstanding performance (e.g., performance-based renewals).

Programs must assess and report on the quality of current and past R&D. For example, NSF's use of Committees of Visitors, which review NSF directorates, is an example of a good quality-assessment tool. OMB and OSTP encourage agencies to provide the means by which their programs may be benchmarked internationally or across agencies, which provides one indicator of program quality.

A. Programs allocating funds through means other than a competitive, merit-based process must justify funding methods and document how quality is maintained. Programs must clearly describe how much of the requested funding will be broadly competitive based on merit, providing compelling justifications for R&D funding allocated through other means. (See OMB Circular A-11 for definitions of competitive merit review and other means of allocating federal research funding.) All program funds allocated through means other than unlimited competition must document the processes they will use to distribute funds to each type of R&D performer (e.g., federal laboratories, federally funded R&D centers, universities). Programs are encouraged to use external assessment of the methods they use to allocate R&D and maintain program quality.

B. Program quality must be assessed periodically through retrospective expert review. Programs must institute a plan for regular, external reviews of the quality of the program's research and research performers, including a plan to use the results from these reviews to

guide future program decisions. Rolling reviews performed every 3-5 years by advisory committees can satisfy this requirement. Benchmarking of scientific leadership and other factors provides an effective means of assessing program quality relative to other programs, other agencies, and other countries.

III. Performance

R&D programs should maintain a set of high priority, multi-year R&D objectives with annual performance measures and milestones that show how one or more outcomes will be reached. Metrics should be defined not only to encourage individual program performance but also to promote, as appropriate, broader goals, such as innovation, cooperation, education, and dissemination of knowledge, applications, or tools.

OMB encourages agencies to make the processes they use to satisfy the Government Performance and Results Act (GRPA) consistent with the goals and metrics they use to satisfy these R&D criteria. Satisfying the R&D performance criteria for a given program should serve to set and evaluate R&D performance goals for the purposes of GPRA. OMB expects goals and performance measures that satisfy the R&D criteria to be reflected in agency performance plans.

Programs must demonstrate an ability to manage in a manner that produces identifiable results. At the same time, taking risks and working towards difficult-to-attain goals are important aspects of good research management, especially for basic research. The intent of the investment criteria is not to drive basic research programs to pursue less risky research that has a greater chance of success. Instead, the Administration will focus on improving the management of basic research programs.

OMB will work with some programs to identify quantitative metrics to compare performance across programs with similar goals. Such comparisons may be within an agency or among agencies.

Construction projects and facility operations will require additional performance metrics. Cost and schedule earned-value metrics for the construction of R&D facilities must be tracked and reported. Within DOE, the Office of Science's formalized independent reviews of technical cost, scope, and schedule baselines and project management of construction projects ("Lehman Reviews") are widely recognized as an effective practice for discovering and correcting problems involved with complex, one-of-a-kind construction projects.

A. Programs may be required to track and report relevant program inputs annually. Programs may be expected to report relevant program inputs, which could include statistics on overhead, intramural/extramural spending, infrastructure, and human capital. These inputs should be discussed with OMB.

B. Programs must define appropriate output and outcome measures, schedules, and decision points. Programs must provide single-and multi-year R&D objectives, with annual performance measures, to track how the program will improve scientific understanding and its application. Programs must provide schedules with annual milestones for future competitions, decisions, and termination points, highlighting

changes from previous schedules. Program proposals must define what would be a minimally effective program and a successful program. Agencies should define appropriate output and outcome measures for all R&D programs, but agencies should not expect fundamental basic research to be able to identify outcomes and measure performance in the same way that applied research or development are able to. Highlighting the results of basic research is important, but it should not come at the expense of risk-taking and innovation. For some basic research programs, OMB may accept the use of qualitative outcome measures and quantitative process metrics. Facilities programs must define metrics and methods (e.g., earned-value reporting) to track development costs and to assess the use and needs of operational facilities over time. If leadership in a particular field is a goal for a program or agency, OMB and OSTP encourage the use of benchmarks to assess the processes and outcomes of the program with respect to leadership. OMB encourages agencies to make the processes they use to satisfy GPRA consistent with the goals and metrics they use to satisfy these R&D criteria.

C. **Program performance must be retrospectively documented annually.** Programs must document performance against previously defined output and outcome metrics, including progress towards objectives, decisions, and termination points or other transitions. Programs with similar goals may be compared on the basis of their performance. OMB will work with agencies to identify such programs and appropriate metrics to enable such comparisons.

IV. Criteria for R&D Programs Developing Technologies That Address Industry Issues

The purpose of some R&D and technology demonstration programs and projects is to introduce some product or concept into the marketplace. However, some of these efforts engage in activities that industry is capable of doing and may discourage or even displace industry investment that would occur otherwise. Programs should avoid duplicating research in areas that are receiving funding from the private sector, especially for evolutionary advances and incremental improvements. For the purposes of assessing federal R&D investments, the following criteria should be used to assess industry-relevant R&D and demonstration projects, including, at OMB discretion, associated construction activities.

OMB will work with programs to identify appropriate measures to compare potential benefits and performance across programs with similar goals, as well as ways to assess market relevance.

A. **Programs and projects must articulate public benefits of the program using uniform benefit indicators across programs and projects with similar goals.** In addition to the public benefits required in the general criteria, all industry-relevant programs and projects must identify and use uniform benefit indicators (including benefit-cost ratios) to enable comparisons of expected benefits across programs and projects. OMB will work with agencies to identify these indicators.

B. **Programs and projects must justify the appropriateness of federal investment.** Programs and projects must demonstrate that industry investment is sub-optimal to develop

a technology or system and explain why the development or acceleration of that technology or system is necessary to meet a federal mission or goals.

C. **Programs and projects must demonstrate that investment in R&D and demonstration activities is a more effective way to support the federal goals than other policy alternatives.** When the federal government chooses to intervene to address market failures, there may be many policy alternatives to address those failures. Among other tools available to the government are legislation, tax policy, regulatory and enforcement efforts, and an integrated combination of these approaches. Agencies should consider that the legislation, tax policy or regulatory or enforcement mechanisms may already be in place to achieve a reasonable expectation of advancing the desired end.

D. **Programs and projects must document industry or market relevance, including readiness of the market to adopt technologies or other outputs.** Programs must assess the likelihood that the target industry will be able to adopt the technology or other program outputs. The level of industry cost sharing or enforceable recoupment commitments in contracts are indicators of industry relevance. Agencies must be able to justify any demonstration activities with an economic analysis of the public and private returns on the public investment.

E. **Program performance plans and reports must include "off ramps" and transition points.** In addition to the schedules and decision points defined in the general criteria, program plans should also identify whether, when, and how aspects of the program may be shifted to the private sector.

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[1] EPA (2003). Strategic Plan for Homeland Security.

[2] HSPD 7: Critical Infrastructure Identification, Prioritization, and Protection designates EPA as the sector specific agency for critical water infrastructure. Designation of EPA as the lead agency for these activities is consistent with the President's National Strategy for Homeland Security (July 2002), which designates EPA as the lead agency for protecting U.S. water resources, from source water through use, treatment, and discharge.

[3] HSPD 9: Defense of the United States Agriculture and Food directs EPA to develop a robust, comprehensive, and fully coordinated surveillance and monitoring program to provide early warning in the event of a terrorist attack using biological, chemical, or radiological contaminants. HSPD 9 also requires EPA to develop a nationwide laboratory network to support the routine monitoring and response requirements of the surveillance and monitoring program

[4] HSPD 10: Biodefense in the 21st Century, currently a classified document, reaffirms EPA's responsibilities under HSPD 9 while adding a clear directive regarding the Agency's responsibilities during decontamination efforts.

[5] NAS (2003). Review of EPA Homeland Security Efforts: Safe Buildings Program Research Implementation Plan.

[6] NAS (2003). Review of the EPA Water Security Research and Technical Support Action Plan: Parts I and II.